TITLE OF THE INVENTION

SCREED PLATE PIVOT

BACKGROUND OF THE INVENTION

This application claims the benefit of U.S. Provisional Application No. 60/265,243, filed January 31, 2001, and U.S. Provisional Application No. 60/265,247, filed January 31, 2001.

The invention relates to paving vehicles, and more particularly to screed assemblies for road paving vehicles.

Paving vehicles or "pavers" are well known and basically function to deposit, level and compact paving material, typically asphalt or concrete, onto a base surface so as to form a mat of paving material. Pavers generally include a vehicle chassis or tractor and a screed assembly towed from the rear of the tractor. A screed assembly generally includes one or more frames connected with the chassis, such as by a pair tow arms, and one or more screed plates mounted to a lower end of the frame(s). The screed assembly is pulled into a mass or "head" of paving material deposited off of the rear of the chassis so that the screed plate(s) first "level" or establish a desired material thickness and then partially compact the paving material flowing under the plate. As a result, a strip or mat of paving material with a desired height or thickness is formed.

Certain screed assemblies include vertically pivotable plates, referred to as "berm plates", mounted adjacent to and outwardly of an inner, generally horizontal screed plate. These berm plates may be used to form upwardly-angled edge sections or "berms" in the material mat, such berms providing sloped curbs to a formed roadway. In order to adjust the angle of the berm

slope, or to permit the screed assembly to be used to form a conventional material mat without berms, the outer berm plate must be pivotably adjusted with respect to the inner screed plate. Typically, the berm plate is adjusted by an actuator, such as a crank-operated, threaded rod-nut arrangement, so that the berm plate pivots about an outer end of the generally horizontal inner plate.

Although functionally necessary, these actuators generally limit the design of known berm-forming screed assemblies in one of the following respects. Some berm-forming assemblies are constructed such that the inner screed plate is not pivotable with respect to the screed frame in frontward-rearward directions. As such, these screed assemblies lack one potential mechanism for adjusting the screed angle of attack, which generally controls the thickness of the formed material mat. With other berm-forming screed assemblies, the actuator must either be temporarily disconnected from the berm plate or the frame, or somehow adjusted along with inner screed plate, to enable the inner screed plate to be pivoted frontwardly or rearwardly.

In view of the above, it would be desirable to have a berm-forming screed assembly with screed plates that are pivotable in frontward-rearward directions, to enable adjustment of the screed angle of attack, without the above-discussed disadvantages of known berm-forming screed assemblies.

SUMMARY OF THE INVENTION

The present invention is a screed assembly for a paving vehicle for forming a mat of paving material upon a base surface. The screed assembly comprises a frame connectable with

the vehicle and a first screed plate movably connected with the frame so as to be rotatably displaceable about a first axis. A second screed plate is movably connected with the first screed plate so as to be rotatably displaceable about a second axis extending generally perpendicular to the first axis. Further, a connective member has a first end connected with the frame and a second end linearly displaceable with respect to the first end. The connective member second end is pivotably connected with the second screed plate such that when the first screed plate rotatably displaces about the first axis, the second screed plate pivotably displaces with respect to the connective member while a distance between the first and second ends of the connective member remains substantially constant.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing summary, as well as the detailed description of the preferred embodiments of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings, which are diagrammatic, embodiments that are presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown. In the drawings:

Fig. 1 is a perspective view of a paving vehicle having a screed assembly in accordance with the present invention, shown performing a berm-forming paving operation;

Fig. 2 is a more diagrammatic, top plan view of the paving vehicle having two of the present screed assemblies;

Fig. 3 is rear elevational view of the screed assembly as configured to mount onto a left side of a main screed;

Fig. 4 is a view taken along line 4-4 of Fig. 3;

Fig. 5 is a more diagrammatic, rear elevational view of a the screed assembly, depicting an assembly configured to mount onto a right side of a main screed and showing an alternative mounting arrangement of a connective member;

Fig. 6 is a perspective view of a screed plate assembly;

Fig. 7 is an enlarged, broken-away perspective view of a screed plate hinge assembly;

Fig. 8 is rear elevational view of a screed assembly frame and adjustment mechanism;

Fig. 9 is a broken-away, perspective view of the screed assembly;

Fig. 10 is an enlarged, broken-away rear elevational view of the outer lateral end portion of the screed assembly;

Fig. 11 is a greatly enlarged view along line 11-11 of Fig. 10;

Fig. 12 is a broken-away rear elevational view of the screed assembly, depicting the second screed plate in an angled orientation with respect to the first screed plate; and

Figs. 13A and 13B, collectively Fig. 13, are each a broken-away, more diagrammatic side elevational view of the screed assembly, each depicting a different orientation of the screed plates about a first pivot axis (extending from the page).

DETAILED DESCRIPTION OF THE INVENTION

Certain terminology is used in the following description for convenience only and is not limiting. The words "upper", "upward", and "lower" refer to directions toward and away from, respectively, a designated upper end of the screed assembly or a component thereof. The words "inner" "inwardly" and "outer" refer to directions toward and away from, respectively, a designated centerline of the paving vehicle or a specified axis, the particular meaning intended being readily

apparent from the context of the description. Further, the term "front", "frontward" and "rear", "rearward" refer to directions toward and away from, respectively, a designated front end of a paver, the screed assembly or a component thereof. Furthermore, the term "circumferential" refers to elements that are oriented so as to be partially or completely extending about a designated center, centerline or axis. The terminology includes the words specifically mentioned above, derivatives thereof, and words or similar import.

Referring now to the drawings in detail, wherein like numbers are used to indicate like elements throughout, there is shown in Figs. 1-13 a presently preferred embodiment of a berm-forming screed assembly 10 for a paving vehicle 1 for forming a mat of paving material M upon a generally horizontal base surface S_B. The vehicle 1 has a generally horizontal, longitudinal centerline 2 extending through front and rear ends 1a, 1b of the vehicle 1 and the material mat M has a generally horizontal upper surface S_M and may include one or more berm edge sections B, as discussed below. The screed assembly 10 basically comprises a frame 12 connectable with a chassis 3 of the vehicle 1, a first screed plate 14 movably connected with the frame 12, a second screed plate 16 movably connected with the first plate 14 and a connective member 18 extending between the frame 12 and the second plate 16.

The first screed plate 14 has a first working surface 15 and is movably connected with the frame 12 so as to be rotatably displaceable about a first, generally horizontal pivot axis 20, which extends generally perpendicular to the vehicle centerline 2. Rotational displacement of the first screed plate 14 about the first axis 20 adjusts the screed angle of attack α (see Fig.

13B), as discussed below. The second screed plate 16 has a second working surface 17 and is movably connected with the first screed plate 14 so as to be rotatably displaceable about a second, generally horizontal pivot axis 22 extending generally perpendicular to the first axis 20 and also generally parallel to the vehicle centerline 2. By rotatably displacing or pivoting the second screed plate 16 about the second pivot axis 22, the second plate working surface 17 is adjustably positionable with respect to the first plate working surface 15. Such adjustment between the two screed working surfaces 15 and 17 enables the screed assembly 10 to be switched between conventional and berm-forming paving operations, and also to vary the angle of a berm section B formed by the assembly 10, as discussed above and in further detail below.

Further, the connective member 18 has a first end 24 connected with the frame 12 and a second end 26 linearly displaceable with respect to the first end 24. The second end 26 is pivotably connected with the second screed plate 16 such that, when the first screed plate 14 rotatably displaces about the first axis 20, the second screed plate 16 pivotably displaces with respect to the connective member 18 while a variable distance D between the first and second ends 24, 26, respectively, of the connective member 18 remains substantially constant. In other words, the connective member second end 26 remains substantially stationary with respect to the connective member first end 24 when the second screed plate 16 pivots about the connective member 18.

More specifically, the second screed plate 16 is rotatably displaceable about a third pivot axis 23 extending through the second end 26 of the connective member 18. The third pivot axis

23 is located so as to be substantially collinear with the first pivot axis 20 when the first and second screed working surfaces 15, 17, respectively, are generally disposed within a common, generally horizontal plane (i.e., the screed plates 14, 16 are generally aligned), as shown in Figs. 3-5. With this arrangement, the angle of attack α (Fig. 13B) of the screed assembly 10 may be adjusted, by pivoting the first screed plate 14 about the first pivot axis 20 (and thus also the connected second plate 16), without the need to adjust the connective member 18, as discussed in further detail below.

Referring now to Figs. 1 and 2, the berm-forming screed assembly 10 is preferably constructed as a screed extension which is either fixedly or movably attached to a primary or "main" screed 6, and most preferably as a power extendible and retractable, front-mounted screed extension. Further, two of the present screed assemblies 10 are preferably connected with the vehicle 1, each screed assembly 10 being mounted near a separate lateral end 6a of the main screed 6. Alternatively, the screed assembly 10 may be constructed as a lateral end portion of the main screed 6 itself, such that the screed frame 12 is part of the main screed frame (not shown). In this case, the main screed 6 preferably has two screed assemblies 10 each formed at a separate lateral end 6a thereof (structure not depicted). Further, the main screed frame 6 is preferably connected to the vehicle chassis 3 by a pair of tow arms 7 extending rearwardly from the chassis 3. Furthermore, the present invention encompasses all appropriate configurations for connecting the screed assembly 10 to a paving vehicle 1 and includes both directly connecting the frame 12 to the vehicle 1 (e.g., through a pair of tow arms 7) or connecting the frame 12

to another screed frame (e.g., main screed 6) or another component more directly connected with the vehicle 1.

Referring to Figs. 3 and 8, preferably, the screed frame 12 is primarily constructed as a generally rectangular, box-like assembly of vertical and horizontal plates attached together by appropriate means, such as by weldment material, rivets or bolts. The frame 12 preferably has three connected portions or subframes: a relatively large upper rectangular subframe 30, a lower, inner subframe 32 and a lower, outer subframe 34. With this structure, the first screed plate 14 is preferably attached to the inner subframe 32 and the second screed plate 16 is preferably connected with the outer subframe 34, as discussed below. Preferably, the inner subframe 32 includes two vertical side walls 33, which are spaced apart laterally along the first pivot axis 20, to which the first screed plate 14 is pivotally attached, as described in further detail below.

However, the frame 12 and/or the subframes 30, 32 and 34 may be constructed in any other appropriate manner, such as for example, a skeletal truss of bars, a solid box, an open platform, etc., and/or may be formed of any desired shape or configuration, such as generally square, ovular, complex-shaped, etc. (no alternatives depicted). The scope of the present invention is not limited to any particular structure for the frame 12 as it is only necessary for the berm-forming screed assembly 10 to have some type of a frame or other base to which the two screed plates 14, 16 and the connective member 18 may be connected and arranged as described herein.

Referring now to Figs. 3-7, the first screed plate 14 is preferably formed as an elongated generally rectangular plate

having a generally constant thickness. More specifically, the first screed plate 14 has a generally flat, horizontal lower surface providing the working surface 15 and an opposing, generally flat, horizontal upper surface 36. Further, the first plate 14 has inner and outer (i.e., with respect to axis 22), side edges 38 and 40, respectively a front upwardly-bended leading edge or nose 42 and a rear edge 44. The screed nose 42 is preferably integrally formed with the remainder of the screed plate 14, but may alternatively be provided as a separate removable or non-removable attachment to the plate 14 (not shown).

Preferably, the first screed plate 14 further includes a pair of attachment blocks 46 spaced laterally apart and attached to the rear surface of the nose 42. The two attachment blocks 46 are used to rotatably connect the first screed plate 14 with the screed frame 12, specifically with the inner subframe 32, as discussed below. Further, a pair of pivot handle blocks 50 are spaced laterally apart and attached to the plate upper surface 36 proximal to the plate rear edge 46. These handle blocks 50 are connected with a preferred pivot adjustment mechanism used to rotatably displace or pivot the first screed plate 14 about the first pivot axis 20, as described in detail below.

Referring to Figs. 3-5 and 9, with the preferred structure described above, the first screed plate 14 is rotatably connected to the frame 12 by pivotably attaching each of the two attachment blocks 46 to the lower end of a separate one of the side walls 33 of the inner subframe 32. Most preferably, two pin shafts 47 are each inserted through a separate one of the two blocks 46 and the proximal one of the side walls 33 so as to rotatably connect the plate 14 with the frame 12. The two pins

47 are axially aligned with each other and establish the position of the first pivot axis 20, i.e., the pivot axis 20 extends between and through the two pin shafts 47. With this structure, the first screed plate 14 is rotatably or pivotably displaceable about the first pivot axis 20 by pivoting the attachment blocks 46 upon the pin shafts 47.

Although the above-described structure is preferred, the first screed plate 14 may be rotatably connected to the frame 12 by any other appropriate means. For example, the screed plate 14 may be connected with the frame 12 by a single elongated bar (not shown) extending between the two attachment blocks 46 and through the frame side walls 33, by a pair of bearing assemblies (not shown) connected between the first plate 14 and the frame 12, or by one or more linkages extending between the frame 12 and the screed plate 14 (none shown).

Referring now to Figs. 3, 8 and 9, the screed assembly 10 preferably includes a pivot adjustment assembly 52 configured to rotatably displace or pivot the first screed plate 14 about the first pivot axis 20. The adjustment assembly 52 includes a pair of crank mechanisms 54 that each extend between the inner subframe 32 and a proximal one of the two handle blocks 50 on the screed plate 14. Each crank mechanism 54 includes a rocker plate 56 pivotably mounted to a base block 57 attached to the subframe 32, a connector rod 58 having a first end 58a attached to the rocker plate 56 and a second end 58b attached to the proximal handle block 50, and a threaded actuator block 60 attached the rocker plate 56.

More specifically, each rocker plate 56 is preferably generally triangular-shaped and has a first corner pivotably

attached the associated base block 57 by a pin shaft 62, a second corner pivotably attached to the associated connector rod 58 by a pin shaft 63 and a third corner onto which the associated actuator block 60 is fixedly (i.e., non-pivotably) attached. Each of the actuator blocks 60 has a threaded hole (not indicated) through which extends an elongated actuator rod 64. The actuator rod 64 has a central axis 65 and two oppositely threaded sections 64a, 64b. Further, the rod 64 extends through the two actuator blocks 60 of both crank mechanisms 54, such that each threaded rod section 64a, 64b is threadably engaged with the hole of a separate one of the blocks 60. Furthermore, the actuator rod 64 extends through a bearing opening 66a in an outer sidewall 66 of the frame 12, the outermost end 64c of the rod 64 being connectable with a handle, a wrench or another appropriate means to rotate the rod 64 (none shown).

With this structure, the pivot adjustment mechanism 52 operates to rotatably displace the first screed plate 14 about the first axis 20, and thus also rotate the connected second screed plate 16, in the following manner. The actuator rod 64 is rotated about its central axis 65 by appropriate means to cause the actuator blocks 60 to displace linearly along the threaded sections 64a, 64b of the rod 64 in opposite, generally horizontal directions. The horizontal displacement of each actuator block 60 causes the attached rocker plate 56 to pivot about its pin shaft 62, thereby causing the two connector rods 58 to displace vertically upwardly or downwardly in the same direction, the particular vertical direction depending on the direction of rotation of the actuator rod 64. Further, the vertical displacement of the two connector rods 58 vertically displaces the attached handle blocks 50, thereby pushing or

pulling the first screed plate 14 so as to cause the plate 14 to rotatably displace or pivot about the two pivot shafts 47, and thus about the first pivot axis 20.

Although the above-described pivot adjustment mechanism 52 is presently preferred, it is within the scope of the present invention to utilize any other appropriate mechanism to rotatably displace the first screed plate 14 about the first axis 20. For example, the screed assembly may alternatively include a motorized pulley and cable arrangement, a rack and pinion mechanism, another linkage structure actuated by a threaded rod or a motor, etc. The present invention encompasses these and any other appropriate apparatus for pivoting or rotatably displacing the first screed plate 14 about the first axis 20.

Referring to Figs. 3-7 and 9, the second screed plate 16 is also preferably formed as an elongated generally rectangular plate having a generally constant thickness, preferably about the same thickness as the first plate 14. The second screed plate 16 has a generally flat lower surface providing the second working surface 17 and an opposing, generally flat upper surface 68. Further, the second screed plate 16 has inner and outer side edges 70 and 72 (i.e., with respect to axis 22), respectively, a front upwardly-bended leading edge or nose 74 and a rear edge 76. As with the first screed plate 14, the screed nose 74 is preferably integrally formed with the screed plate 16, but may be provided as a separate attachment.

Further, the second screed plate 16 preferably includes a single attachment block 78 attached to the plate upper surface 68 proximal to the nose 74, which is used to movably connect the

screed plate 16 to the frame 12 through the connective member 18, as discussed in further detail below. Furthermore, the second screed plate 16 preferably includes a three-sided shield wall 80 attached to the plate upper surface 68 near the outer side edge 72. The shield wall 80 functions (in addition to the nose 74) to prevent paving material from accumulating on the upper surface 68 of the second screed plate 16, as such material would make it difficult to rotatably displace the second screed plate 16 about the second pivot axis 22.

Referring now to Figs. 6, 7 and 9, preferably, the second screed plate 16 is movably connected to the first screed plate 14 by means of a hinge device 82 designed to substantially prevent formation of any gap between the two screed plates 14 and 16, as discussed below. The hinge device 82 preferably includes a pivot body 84 attached to the inner side edge 38 of the first screed plate 14, a first hinge member 86 attached to the upper surface 36 of the first screed plate 14 and a second hinge member 88 attached to the upper surface 68 of the second screed plate 16. The pivot body 84 is preferably formed as a generally cylindrical bar having a longitudinal centerline, which provides the second pivot axis 22, and an outer circumferential surface providing a bearing surface 85. The inner side edge 70 of the second screed plate 16 is disposed against the pivot body bearing surface 85 such that the plate side edge 70 slides against, and remains substantially in contact with, the bearing surface 85 when the second screed plate 16 rotatably displaces about the second pivot axis 22.

By maintaining contact between the second plate 16 and the pivot body 84, a generally continuous working surface extends between the outer side edge 40 of the first screed plate 14 and

the outer side edge 72 of the second screed plate 16, regardless of the relative position of the first and second screed plates 14, 16, respectively. More specifically, this continuous working surface is provided by the first screed plate working surface 15, the second screed plate working surface 17, and the portion of the pivot body outer surface between the first plate inner side edge 38 and the second plate inner side edge 70. Such a continuous working surface across the screed assembly 10 is important to prevent the formation of an elevated stripe or ridge of material in the finished material mat M, which would be created if there was any gap between the inner side edges 38, 70 of the screed plates 14, 16, respectively.

Referring particularly to Fig. 7, the first hinge member 86 is preferably formed as an arcuate plate having an inner circumferential surface 87. The first hinge member 86 is located proximal to the inner side edge 38 of the first screed plate 14 and positioned such that an arcuate gap 90 is formed between the first hinge member 86 and the pivot body 84. The second hinge member 88 is also preferably formed as an arcuate plate having inner and outer circumferential surfaces 89, 91, respectively, and is located proximal to, and extends over, the inner side edge 70 of the second screed plate 16. The second plate 88 is sized to fit within the arcuate gap 90 such that the concave second hinge member inner surface 89 is disposed against convex pivot bearing surface 85 and the convex second member outer surface 91 is disposed against the concave first hinge member inner surface 87. With this arrangement, the second hinge member 88 is slidably retained between the pivot body 84 and the first hinge member 86 so as to rotatably connect the second screed plate 16 to the first screed plate 14.

Although it is presently preferred to use the above-described hinge device 82 to movably connect the second screed plate 16 with the first screed plate 14, the scope of the present invention encompasses any other appropriate means for rotatably connecting the two screed plates 14 and 16. For example, although not preferred, the two screed plates 14, 16 may be pivotably connected by a more conventional hinge (not shown) constructed such that the second plate 16 is "swingable" between a first position, where the two screed plates 14, 16 are both horizontal and abutted end-to-end, and a second position where the screed plates 14, 16 are separated by a gap and the second plate 16 is angled upwardly with respect to the first plate 14. It is within the scope of the present invention to movably connect the second screed plate 16 with the first screed plate 14 by this or any other appropriate means that permit the second plate 16 to rotatably displace about the second pivot axis 22.

Referring now to Figs. 3 and 9-13, the connective member 18 is configured so as to have an adjustable length such that the member second end 26 is linearly displaceable with respect to the member first end 24, as discussed above. More specifically, the connective member 18 has a centerline 25 extending generally between the first and second ends 24 and 26, respectively, and the second end 24 displaces along the centerline 25 such that the distance D_C (Figs. 3 and 10) between the two member ends 24, 26 thereby varies. As the connective member second end 26 is attached to the second screed plate 16, such linear displacement of the second end 26 causes (i.e., pushes or pulls) the second screed plate 16 to rotatably displace about the second pivot axis 22. Further, the connective member 18 is preferably arranged on the screed assembly 10 such that the connective

member centerline 25 and the first pivot axis 20 are generally disposed within a common, substantially vertical plane, i.e., the connective member centerline 25 is spaced substantially above and intersects with the first pivot axis 20. Further, the connective member 18 is preferably angled so as to extend upwardly and inwardly (i.e., toward the vehicle centerline 2) from the second end 26 to the first end 24 (e.g. Fig. 13), but may alternatively be oriented generally vertically, with the first end 24 disposed generally above the second end 26, as depicted in Figs. 5 and 13.

Referring to Figs. 10-12, as discussed above, the connective member 18 is pivotably attached to the second screed plate 16 such that the second plate 16 is pivotably displaceable about the third pivot axis 23. The third pivot axis 23 is located with respect to the second screed plate 16 such that the first pivot axis 20 and the third pivot axis 23 each extend substantially perpendicular to (but spaced above) the second pivot axis 22, as indicated in Figs. 3, 4 and 12. Preferably, the two axes 20, 23 are each spaced a substantially equal perpendicular distance D_P above the second axis 22, in other words, an equal distance in a perpendicular or radial direction with respect to the second axis 22 (as shown in Fig. 12). This distance D_P is established by the location of through holes (not indicated) through the attachment blocks 46 and 78 relative to the centerline of the pivot body 84. Alternatively, each of the two axes 20, 23 may intersect the second pivot axis 22, such as if the first plate upper surface 37 was directly attached to the frame 12 and the connective member second end 26 was attached to the second plate supper surface 68. In either case, the first pivot axis 20 and the third pivot axis 23 are thereby

substantially collinear when the two screed plates 14 and 16 are generally aligned (see e.g., Figs. 3 and 5), as discussed above.

With the above structure, the first and second screed plates 14, 16, respectively, are able to pivot as a single unit about the first pivot axis 20 in order to adjust the angle of attack α (indicated in Fig. 13B), regardless of the particular rotational position of the second screed plate 16 about the second pivot axis 22. In other words, the second screed plate 16 may either be generally aligned with the first plate 14 or may be disposed at any angle β (Fig. 12) with respect to the first plate 14 (as discussed below) and the two screed plates 14, 16 are able to rotatably displace about the first pivot axis 20 without the need to adjust the length of the connective member 18. Thus, when the first screed plate 14 rotatably displaces with respect to the screed frame 12 by a particular angular distance about the first axis 20, the attached second screed plate 16 is thereby rotatably displaced with respect to the connective member 18 by an equal angular distance about the third axis 23. The described capability is provided by the relationship between the three pivot axes 20, 22, and 23 as described above.

Preferably, the connective member 18 is a hydraulic cylinder 92, and most preferably a double-acting single rod cylinder including a cylinder body 93 and an extendable piston rod 94. The outer end of the cylinder body 93 provides the connective member first end 24 and the free end of the piston rod 94 provides the connective member second end 26. The end of rod 94 is attached to the attachment member 78, preferably by a self-aligning pivot device 95, as described below, to connect

the hydraulic cylinder 92 to the second screed plate 16. Alternatively, the hydraulic cylinder 92 may be inverted such that the rod 94 is attached to the frame 12 and the cylinder body 93 is attached to the second plate 16. Further, the connective member 18 may alternatively be provided by any other appropriate connective device/assembly having a second end 26 displaceable with respect to a first end 24, such as for example, a threaded rod and nut/threaded hole arrangement, a cable and pulley device, a rack and pinion mechanism, or a linkage mechanism.

Referring to Figs. 10 and 11, the screed assembly 10 preferably includes a self-aligning pivot device 95 used to attach the connective member 18 to the second screed plate 16. The pivot device 95 includes a first, inner annular body portion 96 attached to the second screed plate 16 and a second, outer annular body portion 97 attached to the connective member second end 26. The second portion 97 is movably attached to the first portion 96; more specifically, the first annular body portion 96 is movably disposed within a generally circular bore through the second, outer annular body portion 97. Further, the pivot device 95 is configured such that each pivot body portion 96, 97 is rotatably displaceable with respect to the other body portion 97 or 96 at least partially about the third pivot axis 23 and also at least partially about a fourth pivot axis 98 extending generally perpendicular to the third pivot axis 23.

With this configuration, when the first screed plate 14 rotatably displaces about the first pivot axis 20 through an angle α, corresponding movement of the second screed plate 16 causes the attached first pivot body portion 96 to rotatably

displace through an equal angle α (Figs. 11 and 13) with respect to the second pivot body portion 97 (attached to the connective member 18) about the third pivot axis 23 so that the connective member second end 26 remains substantially stationary with respect to the connective member first end 24 (see Figs. 11 and 13). Further, when it is desired to pivot the second screed plate 16 about the second pivot axis 22 to adjust the berm angle β (Fig. 12), the second pivot body portion 97, attached to the connective member 18, rotatably displaces with respect to the first pivot body portion 96 about the fourth axis 98, which enables the connective member second end 26 to linearly displace (i.e., toward or away from) with respect to the connective member first end 24.

Preferably, the first end 24 of the connective member 18 is attached to the screed frame 12 by another self-aligning pivot device 95. Further, each of the self-aligning pivot devices 95 is preferably a commercially available rod end bearing, and most preferably an MM Series Male Rod End manufactured by Aurora Bearing Company of Aurora, Illinois. However, it is within the scope of the present invention to have any appropriate type of pivot device to rotatably connect the connective member 18 to the second screed plate 16, such as for example, a ball-and-socket joint device (not shown).

Referring to Fig. 9, the screed assembly 10 preferably further includes hydraulic lines 99 connecting the preferred cylinder 92 with an appropriate hydraulic circuit and controller (neither shown) to control the extension and retraction of the piston rod 94. Alternatively, the screed assembly 10 may be provided with appropriate electrical circuitry and components if

the connective member 18 includes an electric motor or may be provided without any hydraulic or electrical components if the connective member 18 is manually activated (e.g., by a crank turning a threaded rod) (no alternatives shown).

Referring now to Figs. 1-3, 5, 9, 10 and 12, the berm-forming screed assembly 10 of the present invention, when connected with a paving vehicle 1, may be used to either form a conventional material mat M, with a crowned or a generally flat, horizontal upper surface (see left side of Fig. 1), or alternatively to form a material mat M with an upwardly angled berm edge section B, as shown in the right side of Fig. 1 and in Fig. 2. Referring to Figs. 3, 5, 9 and 10, in a first operating mode used to form a conventional material mat M, the first and second screed plates 14, 16, respectively, are each generally aligned such that the respective first and second working surfaces 15 and 17 are generally disposed in a common, generally horizontal plane (not indicated). With this configuration, when the two screed plates 14, 16 are pulled into a head of paving material, the working surfaces 15, 17 level the material flowing under the plates so as to establish a generally constant material thickness across the width of the mat M, as shown in the left side of Fig. 1.

In a second operating mode used to form a material mat with one or more berms (i.e., at either or both mat edges E), the second screed plate 16 is positioned at an acute vertical angle β (referred to herein as the "berm" angle) with respect to the first screed plate 14, the berm angle β having a value of greater than zero degrees (0°) (i.e., the plates 14, 16 are not aligned in a horizontal plane), as best shown in Fig. 12. As such, the

first working surface 15 is disposed in a generally horizontal plane and the second working surface 17 is disposed in an angled plane that extends upwardly and outwardly from the inner edge 38 of the first screed plate 14. When arranged in this configuration, the screed assembly 10 forms the material mat M with two sections, a first angled berm section B and a remaining, generally horizontal section R, as shown in the right side of Fig. 1 and in Fig. 2.

More specifically, the angled berm section B is located at the lateral side or edge of the material mat M and has an upper surface S_A disposed at about the vertical angle β with respect to an upper surface S_R of the remaining section R of the material mat M. Further, the berm section B has a tapering material thickness or height with respect to the base surface S that is generally greater than the generally uniform thickness of the remaining mat section R. In other words, the thickness of the berm section B tapers linearly from a maximum thickness at the mat edge E to a minimum thickness at the interface I with the remaining mat section R, as best shown in Fig. 1.

In the preferred application where the paving vehicle 1 has two berm-forming screed assemblies 10, the two screed assemblies 10 may be positioned in any one of three possible relative configurations, as follows. In a first configuration shown in Fig. 2, both second plates 16 are angled upwardly so as to form a material mat M with two berm sections B (i.e., one at each side edge), the second plates 14 of the two assemblies being disposed at the same or a different berm angle β, as desired. In a second configuration, the second screed plate 16 of one assembly 10 is angled upwardly with respect to the associated

inner first plate 14 and the second screed plate 16 of the other assembly 10 is disposed generally aligned to the associated first plate 14, such that a single berm B is formed at one lateral side of the mat M, as shown in Fig. 1. In the third operating mode, the second screed plates 16 of both screed assemblies 10 are positioned aligned with the associated first plate 14, such that the paving vehicle 1 forms a conventional material mat M (not shown).

To change between the basic operating modes, or to adjust the berm angle β between the screed working surfaces 15 and 17, the second screed plate 16 is rotatably displaced about the second pivot axis 22 by use of the connective member 18, as described in detail above. Preferably, the screed operator adjusts the second plate 16 through a controller (not shown) configured to automatically operate the preferred hydraulic cylinder(s) 92. Further, when the paver 1 has two screed assemblies 10 as preferred, the operator preferably independently operates each of the two connective members 18 of the two screed assemblies 10.

Furthermore, in either the conventional or the berm-forming operating modes, the height or thickness of the material mat M formed by the screed assembly 10 may be adjusted, i.e., increased or decreased, by adjusting the angle of attack α of the screed plates 14 and 16, as indicated in Fig. 13B. However, primary adjustment of the angle of attack α may be performed by adjusting the angle of the main screed 6 with respect to the tow arms 7 or the angle of the tow arms 7 with respect to the paving vehicle chassis 3. As discussed above, the angle of attack α is an acute vertical angle between each of the screed working

surface 15 and 17 (and thus also the plates 14 and 16) and the base surface S (e.g., a roadway base).

Further, rotational displacement of the first screed plate 14 about the first pivot axis 20 adjusts the vertical angle α between the working surface 15 of the first screed plate 14 and the base surface S. As the second screed plate 16 is connected with the first screed plate 14, rotational displacement of the first screed plate 14 causes a substantially equal adjustment to the angle of attack α of the second screed plate 16, as shown in Fig. 13B. As stated above, the angle of attack α may be adjusted merely by pivoting the first screed plate 14 about the first pivot axis 20, preferably by turning the actuator rod 64 of the adjustment assembly 52, as a result of the described structure of the screed assembly 10 of the present invention.

The screed assembly 10 of the present invention is clearly advantageous over previously known berm-forming screed assemblies as discussed in the Background section of this disclosure. As discussed above, the angle of attack α is adjustable by pivoting the screed plates 14, 16 with respect to the screed frame 12, unlike certain known screed assemblies where adjustment of the angle of attack α could only be performed by adjusting the screed frame itself or the tow arms. Further, with the screed assembly 10 of the present invention, such adjustment of the angle of attack α occurs in a single step and without the need to adjust or temporarily disconnect the connective member 18.

It will be appreciated by those skilled in the art that changes could be made to the embodiments described above without

departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiments disclosed, but it is intended to cover modifications within the spirit and scope of the present invention as defined by the appended claims.